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A model for rapid emergency department expansion for the COVID-19 pandemic

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ABSTRACT

COVID-19 has caused global dramatic change in medical practices including the introduction of temporary screening and assessment areas outside the footprint of the main hospital structures. Following the initial surge of patients with novel coronavirus (2019-nCoV) in the United States, our medical center rapidly designed and constructed an alternative assessment and treatment site in a converted parking garage deck for emergency department patients with suspected or confirmed 2019-nCoV. During the first month after opening, 651 patients were treated in this alternative assessment area including 54 patients who tested positive for 2019-nCoV. This accounted for 55% of the 98 patients with confirmed novel coronavirus (2019-nCoV) who were treated in our ED. This report provides a blueprint for the necessary steps, materials, labor needs and barriers, both anticipated and unanticipated, to rapidly construct an alternative ED treatment site during a pandemic.

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1. Background

The rapid spread of a novel coronavirus (2019-nCoV) across the world in early 2020 has dramatically affected the global healthcare system. Early data out of the Chinese and Italian outbreaks suggested that when the disease reached the United States, our healthcare resources and endemic healthcare population would likely be at risk [1]. Sparse published literature also suggests our healthcare workers are equally vulnerable [2] with multiple media outlets reporting similar concerns [3,4]. In response, hospitals across the nation prepared to receive higher volumes of patients infected with 2019-nCoV [5].

After witnessing multiple European and New York City Hospitals overwhelmed by a large number of 2019-nCoV infected patients, our hospital and emergency medicine leadership teams saw the urgent need to create the largest number of additional emergency department (ED) beds in the shortest possible time that could physically sequester patients with a high probability of 2019-nCoV infection. This need was seen as urgent as our medical center, like any other major tertiary care referral centers, has a large number of multisystem diseased patients who are most likely to have the highest morbidity and mortality from 2019-nCoV infection.

Our Medical Center, located approximately 2 miles from a major metropolitan city, is the only level 1 trauma center in the region and provides care to over two million patients per year, many of whom have organ transplants or active chemotherapy regimens. The Hospital Adult Emergency Department (ED) treats approximately 70,000 patients per year with a very high acuity population resulting in nearly 1 in 3 patients admitted to the hospital. The medical center convened an emergency operations committee to develop crisis response plans and surveyed the medical center campus for an appropriate patient assessment area outside the walls of our adult emergency department. Multiple factors needed to be considered in choosing this location (Table 1). A covered parking garage floor, one floor up and separated from the main entrance to the ED by the hospital driveway, was chosen. This assessment area, known as the E pod, was 30,000 square feet and formerly housed 64 parking spaces (Fig. 1a).

2. Construction and supplies management

Construction began in early March with the building of an E pod Work Room which was isolated from the patient assessment areas, had clinical workspaces for the ED physician, advanced practice providers and the nurses assigned to E pod. The ED COVID leadership team agreed upon required equipment and supplies for the E pod (Table 2) including most importantly a supply of personal protective equipment (PPE) and a designated donning/doffing area outside of the work room (Fig. 1b). External fencing with privacy screens were then installed to restrict access to the E pod, protect patient privacy from individuals walking past the street facing side of the parking garage, as well as patient and staff safety. The first 9 patient assessment bays

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Table 1
Factors in choosing Alternative Assessment Area

Location:	Accommodating anticipated number of patients
	Proximity to Emergency Department
	Transportation from Triage
	Transportation to Medical Ward Unit
	Transportation to Intensive Care Unit
	Protection from weather
Facilities:	Power
	Data
	Bathrooms
	Heating/Cooling
Patient Care:	Imaging
	Laboratory studies
	Medical Gas
Safety:	Security
	Privacy

(Fig. 1c) were then built over the next 48 h. Each patient care area had insulated raised temporary flooring, patient privacy barriers, independent power supply and a heating element. The initial 9 assessment bays have treatment chairs. Upon completion of these initial 9 areas, 5 additional patient assessment areas, consisting of 9–10 stretchers per zone (Fig. 1d), were built out based on the layout of the garage parking spaces. Each row of treatment spaces has its own area to don/doff appropriate PPE. A total of 64 assessment areas were constructed. These were built into our Epic electronic health record ED track board so that patients could have orders entered electronically, radiology would be aware of their location, and at times admitted to inpatient units directly from their E pod assignment.

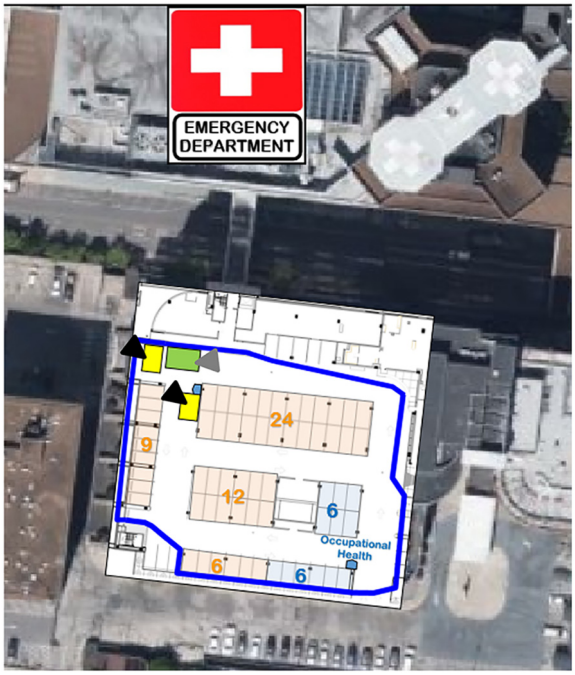

Fig. 1. a Treatment space lay out of *E*-pod (Outlined in blue). The E Pod was constructed on the 2nd floor parking deck across the driveway from the main entrance to the ED. The "Orange" sections represent the E-pod patient treatment areas. The "blue" sections are the occupational health assessment areas for employee screening. Don/Doffing areas were marked for patient and provider safety (Black Arrow) and the provider control room separated from patient care areas (Gray arrow).b Don/Doff area outside of treatment spaces. The area included specific areas for the clinical teams to don and off PPE. Construction included the addition of a sink for hand washing and dedicated areas to hang face shields after cleaning. c First E-pod patient assessment area and treatment space. These chairs would preferentially be used for patients requiring short ED evaluations such as 2019-nCoV testing only, rapid strep testing, or a portable chest radiograph. d E Pod Stretcher treatment spaces for higher acuity patients. Patients requiring longer evaluations including admission to the hospital for complications related to suspected or confirmed 2019-nCoV (e.g. hypoxia requiring supplemental oxygen) were bedded. e Extended Triage Area: Temporary structure constructed between Ambulance Bay (located behind back brick wall) and Main ED Ambulatory Entrance where all hemodynamically stable patients who screened positive for possible 2019-nCoV undergo triage.

Fig. 1 (*continued*).

The total project took approximately 2520 labor hours to create the assessment areas and work area. Materials used were; Laminate floors, Fiberglass walls on metal studs, 2 × 2 grid acoustical tile ceilings, 2 × 2 flag LED panel lights, electrical wiring, data wiring, air flow ducts, individual heaters for patient care areas, patient dividers, and patient chairs. The area was inspected and approved by the local and State licensing boards for patient care.

3. E pod staffing

ED nurses and patient care technicians were reallocated from our main ED staffing to work in E pod. Given the inherent increased exposure to patients under investigation and confirmed 2019-nCoV positive, staff volunteered to work in the E pod. One ED nurse staffed the E pod assessment area with a hierarchy of main ED nursing assignments that would close and move to E pod as E pod patient demand grew. One ED clinician was assigned to see E pod patients at all times. ED clinician coverage was provided by attending physicians and advanced practice providers who were reallocated from our vertical treatment unit during daytime hours. Evening and overnight coverage was provided by our Main ED attendings who would walk over to the E pod and see patients.

Fig. 1 (*continued*).

Fig. 1 (*continued*).

Our ED radiology technicians would walk over from the main ED to perform plain films, mostly portable anteroposterior (AP) chest radiographs, when ordered.

Fig. 1 (*continued*).

4. Extended triage construction and staffing

Our medical center space and facilities team simultaneously constructed a second area immediately outside of our main ED in a narrow throughway between our ambulance entrance and our patient walk-in entrance. This area, called our extended triage (Fig. 1e), served as an isolated triage location for all hemodynamically stable patients who met our 2019-nCoV screening criteria (i.e. patient has one of the following: new cough, new shortness of breath, fever, or loss of smell without other neurologic symptoms) and did not have a complaint concerning for an acute emergent condition (e.g. stroke, STEMI, major trauma, active labor). An experienced ED triage nurse, donned in full PPE, staffed that area with a registration representative, also in full PPE, who would complete patient registrations.

5. Patient flow and evaluation processes

A standardized patient flow process was developed (Fig. 2) that was followed since the unit opened, less than 48 h after the construction started. As part of the PPE conservation efforts, providers were permitted to evaluate multiple patients without doffing their gowns, masks or face shields. As long as providers remained inside the designated 2019-nCoV treatment areas patients could be batched providing more efficient patient care and overall PPE usage. This included our radiology technicians who could perform multiple x-rays while in the treatment area without having to use new full sets of PPE each time. Patients seen in our ED and E Pod were primarily tested for 2019-nCoV using a local RNA-PCR testing. A small number of specimens were sent to outside testing due to a temporary reagent shortage.

6. E pod patient experience

Over the first 35 days since E pod opened, 651 patients were evaluated for complaints associated with possible 2019-nCoV infection. The number of patients evaluated in a single 24-h period ranged from 7 to 51 patients with a median of 15. Of the 651 patients, 539 (83%) have

Table 2
Materials needed for direct patient care in alternative treatment area

Informational Technology:	4 Clinical Work Stations	Medications:	Acetaminophen 325 mg tablets
	1 Printer		Acetaminophen 500 mg tablets
	1 Prescription Printer		Albuterol HFA
			Albuterol nebulization solution
Medical Supplies	Resuscitation cart		Anaphylaxis kit
	IV Start Kits		Dextrose D50W, 25 g
	Blood Collection tubes		Duoneb® solution (Albuterol and Ipratropium)
	Urine Specimen Cups		Ibuprofen 200 mg tablets
	Personal Protective Equipment		Ibuprofen 400 mg tablets
			Lactated Ringers 1000 mL infusion bags
Medical Equipment:	Oxygen Tanks		Glucose tablet packages
	Portable X-ray		Naproxen 500 mg tablets
	Electrocardiogram machine		Oseltamivir 75 mg capsules
			Ondansetron ODT 4 mg tablets
Miscellaneous	Blanket Warmer		Ondansetron 4 mg/2 mL inj.
	Hard Copy discharge instructions (English, Spanish, Arabic)		
	Portable Heater Units		
	Sink		
	Hand Hygiene Dispensers		

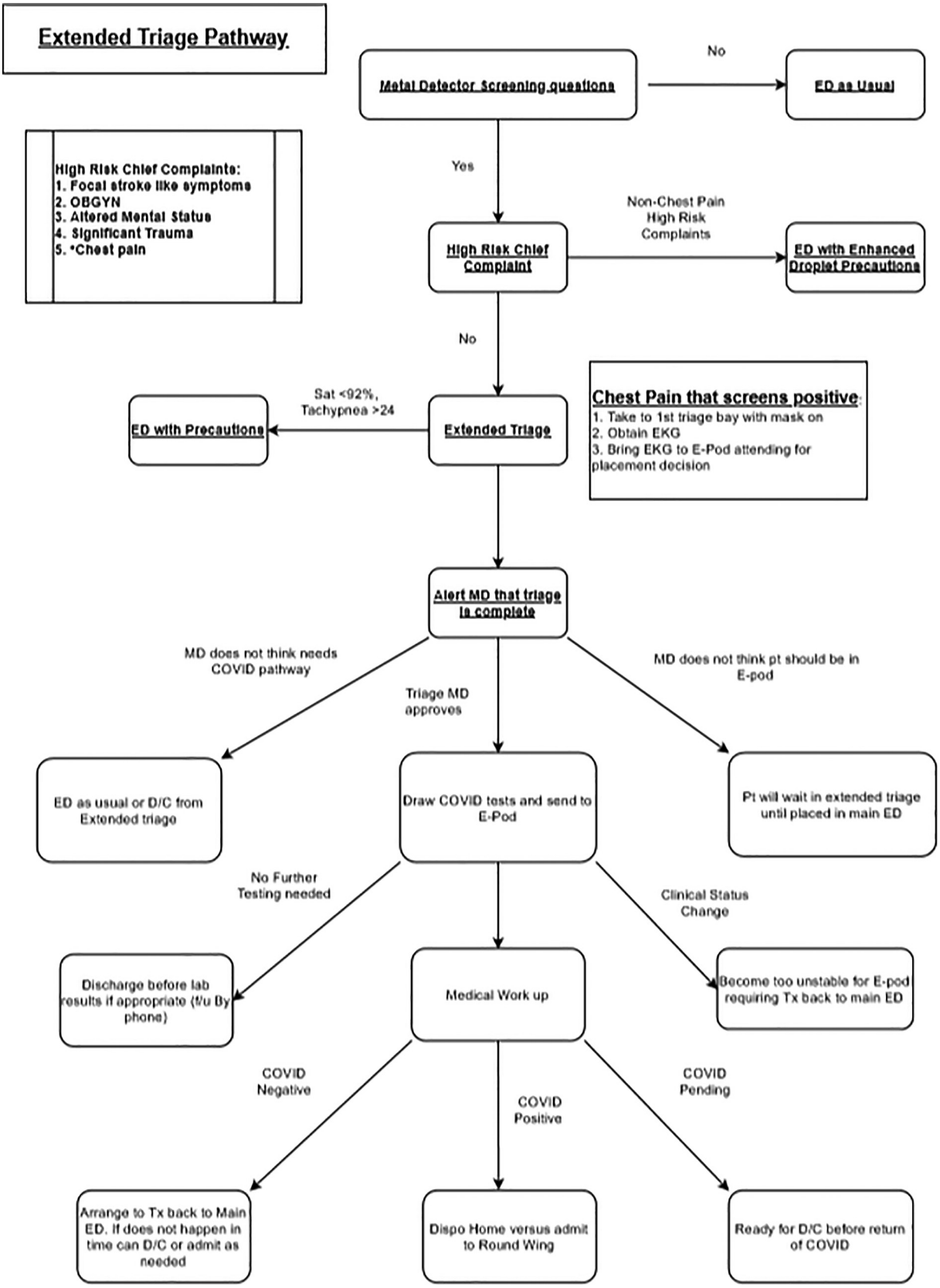

Fig. 2. Patient Flow Pathway from Ambulatory Entrance to E Pod. This flow chart details the triage and assignment of patients based on hemodynamic stability and complaint to the E Pod or a Main ED room with enhanced droplet precautions.

been tested with 54 (8.2%) returning positive for 2019-nCoV. The majority 609 (94%) of patients were discharged directly from E pod with only 42 (6%) admitted to the hospital.

Patients primarily presented with symptoms concerning for 2019-nCoV and required testing. As the pandemic continued, the patient spectrum of illness changed slightly to include individuals with confirmed-positive 2019-nCoV testing who had worsening of their symptoms including some who required hospitalization most often for supplemental oxygen due to hypoxia.

6.1. Discussion on building and instituting an alternative ED 2019-nCoV assessment area

The E pod has functioned very well at achieving its 3 primary objectives by providing a secure location for healthcare workers to safely assess stable patients with confirmed or suspected 2019-nCoV infection while isolated away from our most vulnerable immunocompromised ED patients. This project could not have been attempted or completed without the tireless and expert work of our Space and Facilities team who were able to construct a safe and aesthetically pleasing healthcare assessment area in less than 48 h.

The *E*-pod has treated 54/98 of our ED patients with confirmed 2019-nCoV, meaning 55% of our 2019-nCoV positive patients never entered the main emergency room with our endemic patient population. This helped directly limit both our staff and patient population exposure to 2019-nCoV by providing appropriate distancing between treatment areas, guaranteeing patients being evaluated in appropriate PPE and limiting those patients not under investigation for 2019-nCoV direct exposure in the main emergency department. The 2019-nCoV suspected patients treated in the main ED included those with unstable vitals, chief complaints concerning for non-2019-nCoV emergencies, behavioral health complaints requiring close monitoring and ambulance/air helicopter arrivals. Our leadership group decided not to initially arrive ambulances directly to E pod due to logistical and traffic issues although arriving ambulances directly to E pod is under consideration. Temporary closures due to weather also impacted the overall percentage of patients seen in E pod. The area has also reduced PPE utilization as not all PPE has to be doffed when performing limited evaluations on stable, low acuity patients similar to most ambulatory assessment centers. Patients were rapidly evaluated and dispositioned with specific practice changes (e.g. patients were not required to sign their discharge paperwork with an ink pen, patients were not taken to our discharge station) to minimize potential healthcare worker exposure to the virus.

Fortunately, state-wide social distancing restrictions reduced the expected patient volume to our hospital. Therefore, the medical center converted 9 of the assessment areas to an employee-only testing center where medical center employees could be screened and tested daily in a non-crowded location and not in the ED or the confines of the Occupational Health Clinic.

The biggest barriers were weather related. Our city's ambient temperatures in March often have broad fluctuations from daytime highs in the 80s F to nighttime lows in the 30s. We were able to introduce air movement systems to help but were limited with heating to individual units. We operated the alternative treatment area if the ambient temperature in the treatment spaced stayed above 55 degrees. We also helped maintain patient comfort with the addition of heated blankets. In addition to fluctuating temperature, during times of heavy rain minor flooding would occur. This necessitated the movement of the provider control room as well as use of an alternative treatment area inside the emergency room on two different occasions.

Another obstacle was the use of medical gas, which is especially important with 2019-nCoV's associated hypoxia. The requirement for supplemental heaters due to low ambient temperatures prevented us from having supplemental oxygen tanks due to safety issues surrounding medical gas. As the temperature warms in April, this issue should resolve as we no longer need heaters.

Identifying the ideal patient population for this type of assessment area is also an evolving process. The initial surge of “walking well” individuals with mild symptoms and unknown 2019-nCoV status provided an easily defined target population. As more individuals were tested and the medical community's understanding of the atypical gastrointestinal and cardiovascular symptoms associated with the virus emerged, patient identification and E pod assignment was less consistent. We monitor our daily patient volume and continue to revisit the E pod patient criteria to best align with our goals and the current spectrum of 2019-nCoV illness in our community.

In conclusion, our experience has shown that institutions can rapidly construct alternative ED assessment sites to safely treat patients with confirmed and suspected infection while also reducing potential exposures to other vulnerable patient populations.

Author contributions

All authors conceived the project and the implementation of the new process. NMM, IJ, GC and TWB undertook acquisition and management of data. NMM and TWB drafted the manuscript, and all authors contributed substantially to its revision. NMM takes responsibility for the paper as a whole.

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